

REMARKS / ARGUMENTS

The action by the Examiner in this application, together with the references cited, have been given careful consideration. Following such consideration, claims 20-26 have been added and claim 1 has been amended to define more clearly the patentable invention the Applicants' believe is disclosed herein. This amendment is presented according to revised amendment practice 37 CFR 1.121 effective July 30, 2003. It is respectfully requested that the Examiner consider the claims in their present form, together with the following comments, and allow the application.

As the Examiner well knows, the present invention is generally directed to an injection lance used to stir, trim, and rinse a molten metal such as liquid steel. A typical injection lance is generally comprised of a metal center pipe surrounded by a refractory shell. The injection lance is inserted into molten metal, and a gas (e.g., argon) is introduced into the molten metal through the lance. In this regard, gas is forced into one end of the center pipe, and diffuses into the molten metal through a porous nozzle tip at the other end of the center pipe.

The primary function of the refractory shell is to protect the metal center pipe from melting that would result from exposure to the molten metal. One problem associated with the refractory shell is uneven wear, known as preferential wear, that occurs where the injection lance passes through the slag layer. Preferential wear can also occur at the tip of the injection lance, where gases exit from the center pipe into the molten metal. Preferential wear causes damage to the injection lance such that it must be discarded, even though considerable castable refractory material may remain in other areas of the refractory shell.

One attempt to solve the preferential wear problem has been to use magnesia-carbon sleeves to form the portion of the refractory shell at the slag line. Such a magnesia-carbon sleeve is described in U.S. Patent No. 4,989,838 to Kaldon et al. While magnesia-carbon sleeves have exhibited resistance to attack by the slag, the magnesia-carbon sleeves have a tendency to crack and fall off as a result of thermal shock when the injection lance is inserted into the molten metal. Accordingly, magnesia-carbon sleeves do not provide an injection lance with satisfactory performance.

The present invention provides an injection lance having a refractory shell that is resistant to attack by slag at the slag line, and that is less likely to crack and fall off of the center pipe as a result of thermal shock.

The claimed injection lance includes a first center pipe having anchoring members attached to an outside surface. A first refractory shell surrounds the first center pipe. According to the present invention, the first refractory shell is pressed around the first center pipe such that the anchoring members are embedded into the first refractory shell. The anchoring members within the refractory shell result in a refractory shell that is tightly bonded to the center pipe. The tightly bonded refractory shell is more resistant to cracking and is less likely to separate from the center pipe upon exposure to molten metal, as compared to the magnesia-carbon sleeve of the Kaldon et al. reference.

It is respectfully submitted that none of the cited references teach, suggest, or show an injection lance as presently set forth in the claims, or the advantages thereof.

In response to the Examiner's rejections, claim 1 has been amended to define a lance having a center pipe having "anchoring members attached to an outer surface thereof," and to

define that the anchoring members are “embedded in the first refractory shell....” As indicated above, a benefit of the claimed structure is an injection lance having a refractory shell that is resistant to preferential wear, that is tightly bonded to a center pipe and that is resistant to cracking and separation from the center pipe.

The Examiner has rejected claims 1-15, 18 and 19 under 35 U.S.C. 103(a) as being unpatentable over either U.S. Patent No. 3,565,412 to Moniot or U.S. Patent No. 3,615,085 to Bernsmann in view of U.S. Patent No. 4,989,838 to Kaldon et al.

The Moniot, the Bernsmann, and the Kaldon et al. references disclose an injection lance having a center pipe surrounded by a refractory shell. None of these references teach, suggest, or show a center pipe having “anchoring members” attached to an outer surface thereof.

Applicants are familiar with the Kaldon et al. reference. The cylindrical sleeve disclosed in the cited reference is first formed apart from the center pipe, and is then slid onto the center pipe (that does not have anchoring members attached to it). In this respect, the cylindrical sleeve of the cited reference is not anchored to the center pipe. Accordingly, the Kaldon et al. reference does not teach, suggest, or show anchoring members attached to an outer surface of a center pipe and embedded in a refractory material.

None of these references teaches, suggests, or shows the claimed structure of “at least one body section having a first center pipe having anchoring members attached to an outer surface thereof; a first refractory shell attached to the first center pipe, with the anchoring members being embedded in the first refractory shell....”

The Examiner has rejected claims 1-19 under 35 U.S.C. 103(a) as being unpatentable over the Harbison-Walker blueprints in view of the Kaldon et al reference. The Harbison-

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Walker blueprints show a lance having an isopressed shell that is fitted around an inner conduit. The Harbison-Walker blueprints do not teach, suggest, or show “at least one body section having a first center pipe having anchoring members attached to an outer surface thereof; a first refractory shell attached to the first center pipe with the anchoring members being embedded in the first refractory shell....”

Applicants’ respectfully submit that claim 1 is now in condition for allowance. Because claims 2-19 depend from claim 1, Applicants’ respectfully submit that they too are in condition for allowance.

A new claim 20 has been added and also includes the following limitation: “at least one body section having a first center pipe having anchoring members attached to an outer surface thereof; a first refractory shell isopressed onto the first center pipe with the anchoring members being imbedded in the first refractory shell....”

Applicants’ respectfully submit that claim 20 is now in condition for allowance for the same reasons stated above regarding claim 1. Because claims 21-26 depend from claim 20, the applicants respectfully submit that they too are in condition for allowance.

The prior art made of record and not relied upon has also been reviewed. It is respectfully submitted that none of these additional references teach or suggest the Applicants’ invention as defined by the present claims. In view of the foregoing, it is respectfully submitted that the present application is now in proper condition for allowance. If the Examiner believes there are any further matters which need to be discussed in order to expedite the prosecution of the present application, the Examiner is invited to contact the undersigned.

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If there are any fees necessitated by the foregoing communication, please charge those fees to our Deposit Account No. 50-0537 referencing our Docket No. NR8315US.

Respectfully submitted,

Date: July 29, 2005


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CERTIFICATE OF MAILING UNDER 37 C.F.R. §1.8

I hereby certify that this correspondence (along with any paper referenced as being attached or enclosed) is being deposited on the below date with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to MAIL STOP AMENDMENT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Date: July 29, 2005


Laura K. Cahill